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Alberta Pocket Gopher Survey

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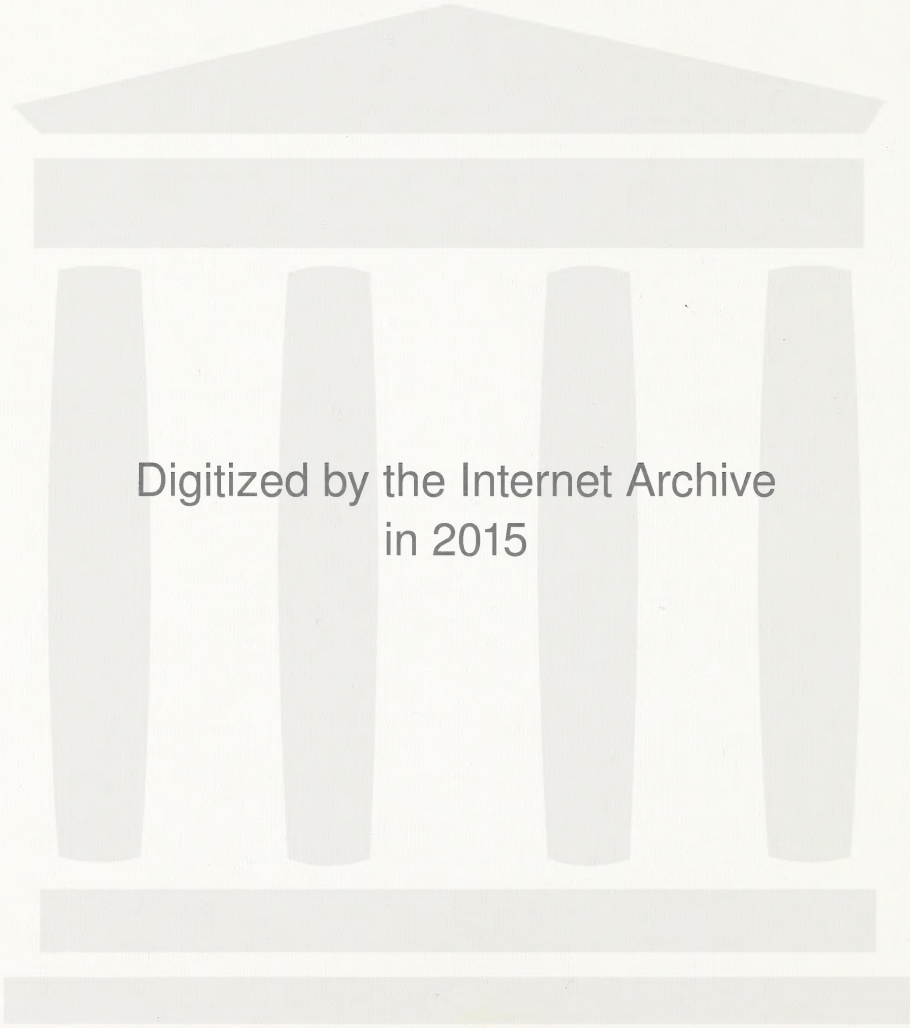

ALBERTA POCKET GOPHER SURVEY

by

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ABSTRACT

A telephone survey of Agricultural Service Board Fieldmen (ASBF) was conducted in 1990 to assess the extent and severity of pocket gopher (*Thomomys talpoides*) problems in Alberta. Additional agricultural data were used to estimate the area inhabited by gophers and the economic loss to Alberta farmers from pocket gopher damage.

Pocket gophers occurred in 48 of 65 municipalities, and were considered a problem in 39 of these areas (15.4% of the area of Alberta). Gopher problems were distributed over 1% to 100% of the total area of municipalities, averaging 54%. Fifty-nine percent of municipalities reporting problems rated problems as moderate, and 31% as severe. Pocket gopher problems were rated more severe in haylands than in pastures by 90% of ASBF. Gopher problems were also associated with sandy soil textures, and were most severe within the black soil zone. Pocket gopher control was advocated by ASBF in 95% of the problem municipalities, but only 39% were satisfied with the methods of control used. More municipalities reported trapping as a satisfactory type of control in comparison to other methods. Pocket gophers were estimated to impact on approximately 722,760 ha of available tame haylands and 729,160 ha of improved pasture, representing 14% of the area over which gophers were considered a problem. The annual economic loss associated with moderate and severe gopher problems occurring on haylands was estimated between $25 and $50 million.

1 INTRODUCTION

Pocket gophers *(Thomomys talpoides)* are important fossorial rodent pests of haylands and pastures in Alberta. They feed on a variety of plants, but prefer legumes and other broad-leaved forbs. Gophers are active throughout the year, spending much of their time feeding on underground plant parts (Keith *et al.*, 1958; Ward, 1960). Surface vegetation, however, may comprise a large part of the diet during the growing season (Ward, 1960). Pocket gophers create complex burrow systems associated with feeding activities resulting in extensive surface mound deposits. The burrow system of one animal may cover 0.5 ha with burrows ranging from just below the surface to over 60 cm deep (Godfrey, 1987). One gopher can produce up to 50 mounds per year (Anonymous 1984a). In heavily infested areas, densities of 123 adults/ha can occur within a few years (Howard and Childs, 1959). Pocket gophers cause significant economic loss to producers. Direct damages include loss of forage production due to consumption and burial from mound formation. Mounding by pocket gophers also contributes to the spread of weeds by providing seedbeds and results in damage to machinery (Anonymous, 1984a). These negative impacts may greatly outweigh benefits of soil turnover and improving filtration rates associated with gopher burrowing activity (Grinnell, 1923; Ellison and Aldous, 1952; Laycock and Richardson, 1975).

A questionnaire directed to agricultural representatives was designed to: (1) determine the extent and severity of pocket gopher problems in Alberta; (2) examine the relationships of soil and forage factors with the occurrence of pocket gophers; (3) document control methods in use and their effectiveness; and (4) estimate the economic loss to producers.

2 METHODS

A telephone survey on pocket gophers was conducted with ASBF from all municipalities (counties, districts, and special areas) of Alberta in 1990. The survey (Appendix 1) consisted of 10 questions referring to the location and severity rating of pocket gopher problems, types of forage and soils gophers are associated with, and methods of control advocated and their effectiveness. Severity of gopher problems was rated based on the percentage of haylands and pasture covered with mounds: light = 0-10%, moderate = 11-34%, and severe = >35%. ASBF familiarity with pocket gopher problems and residence time in their municipality were also addressed. A number of representatives were re-contacted when more specific information or clarification of information was required.

Replies to the questionnaire were summarized. Additional ASBF comments were incorporated into the results where possible. Years of ASBF residence within municipalities was placed into 0-5 years, 6-10 years, and >10 year categories. Goodness-of-fit test (Steel and Torrie, 1960) was used to evaluate differences between numbers of ASBF among residence year classes, and among the familiarity classes (very, moderate, little). The relationship between ASBF residence time and familiarity with pocket gopher problems, ASBF residence years and rating of pocket gopher problems, and ASBF familiarity and rating of pocket gopher problems were examined using Chi square analyses (Steel and Torrie, 1960) or Fisher Exact Probability Test (Siegel, 1956). Pocket gopher distribution and problem ratings were mapped, and their occurrence was evaluated relative to forage type, and soil type and texture. In addition to information obtained from the survey, gopher problem areas were mapped and overlayed on the major soil zones of Alberta (Soil Group Map of Alberta, compiled by the Alberta Institute of Pedology, copyright Government and University of Alberta). Area (ha) of light, moderate, and severe problems were subsequently calculated for each soil zone. Differences in the amount of use and satisfaction of control methods were evaluated using Chi-square analyses (Steel and Torrie, 1960). The effectiveness of control methods in relation to severity of gopher problem was also examined using Fisher Exact Probability Test (Siegel, 1956).

Data on the area of municipalities under tame hay production and under improved pasture obtained from a 1986 Alberta agriculture farm survey (Anonymous, 1987) provided estimates to calculate economic losses within each municipality. Pocket gopher problems were assumed to occur on 100% of the haylands within a municipality unless specified otherwise by the ASBF. Where gopher problem distribution within a municipality was restricted to a specific location, the fraction of the area within the municipality with pocket gopher problems was multiplied by the area of hayland within the municipality. In each municipality an economic cost was calculated for severe and moderate pocket gopher problems occurring on haylands using the following formula:

$$\text{COST} = [(\text{HY} \times \text{HV} \times \text{RY}) + \text{MDR}] \times \#\text{ha hayland}$$

where:

HY	=	hay yield for municipality in tonnes/ha	
HV	=	estimated hay value	- $60/tonne for maximal value
			- $30/tonne for minimal value
RY	=	reduction in yield	- 20% for severe problems
			- 10% for moderate problems
MDR	=	machinery damage and reseeding costs	
			- $15/ha for severe problems
			- $10/ha for moderate problems

Hay yield for municipalities was estimated as the average total hay production values from the crop insurance risk zone which encompassed the majority of that municipality (Anonymous, 1991). If two risk zones were equally represented, the average of both production values was used. Hay value estimates of $30/tonne and $60/tonne were also obtained from crop insurance information, and represented the range of values for compensation of loss. RY values are conservative estimates based on studies which indicate losses in forage production of about 16-45% due to pocket gophers (Alsager, 1977; Foster, 1977; Luce and Case, 1981). MDR are conservative cost estimates based on information from Smoliak et al. (1981), Loree (1992), and 1992 seed retail costs. Assumptions included:

1. Persistence of an average pocket gopher free hay crop = 6 years
2. Persistence of a hay crop with severe infestation = 3 years
3. Persistence of a hay crop with moderate infestation = 4.5 years
4. Cost of re-seeding = $88/ha, (based on; discing @ $24/ha, cultivation @ $22/ha, seeding @ $12/ha, harrow-packing @ $5/ha, and seed cost of $2.50/kg @ 10 kg/ha.
5. Cost of additional repair to haying machinery = $2/ha

3 RESULTS AND DISCUSSION

Sixty-eight agricultural representatives were interviewed from a total of 65 municipalities (30 Counties, 22 Municipal Districts, 10 Improvement Districts, 3 Special Areas) across Alberta. Representatives from all three subdivisions of Improvement District 18 and two subdivisions of Improvement District 17 were included in the survey.

3.1 Residence Years and Familiarity with Pocket Gophers

ASBF were evenly distributed among resident year classes (X^2=1.80, df=2, P≥0.05, Table 1). As well, no significant relationship was found between residence time and familiarity (X^2=7.67, df=4, P≥0.05, Table 1), and overall, 79% of the representatives were either moderately

or very familiar with gophers. Furthermore, years of residence were not related to the severity rating of pocket gopher problems (X^2=4.67, df=2, P>0.05, Table 2), thus, data from all ASBF were combined for the remaining analyses. ASBF were more likely to be familiar with gopher problems in moderate to severe problem areas than in light problem areas (X^2=9.78, df=2, $P \leq 0.05$, Table 2), likely as the result of increased complaints and requests for gopher control information from forage producers.

Table 1. Number of Agricultural Service Board Fieldmen in Alberta within residence year classes and their associated degree of familiarity with pocket gopher problems as reported in 1990 survey.

Years of Residence	No.	Familiarity with Problem	No.
0-5	28	little	6
		moderate	14
		very	7
6-10	18	little	6
		moderate	7
		very	5
>10	23	little	2
		moderate	8
		very	13

Table 2. Number of Agricultural Service Board Fieldmen in Alberta within residence year classes and familiarity classes that rated pocket gopher problems as severe, moderate and light as reported in 1990 survey.

	Severity of Gopher Problem		
	Severe	Moderate	Light
Years of Residence			
0-5	1	10	1
6-10	4	5	1
>10	7	8	2
Familiarity with Gopher Problems			
Little	0	0	1
Moderate	1	12	2
Very	11	11	1

3.2 Pocket Gopher Distribution

Pocket gophers occur in 74% of all municipalities in Alberta (Figure 1). They were strongly associated with central and southern agricultural regions, and did not inhabit agricultural areas of the Peace River Region. Gophers were a problem in 81% of the municipalities in which they occurred, the distribution of the problem covering approximately 10,021,000 ha or 15.4% of Alberta (Figure 2). The northern limit of gopher problems was 55° 17'N and the western limit was 115° 30'W. Of the few pocket gopher problems associated with the southeastern portion of the province, those of moderate severity coincided with the northern portion of the Eastern Irrigation District, and with a portion of the Taber and St. Mary River Irrigation Districts. Within individual municipalities, the distribution of pocket gopher problems varied from very localized to dispersed throughout. Problem areas ranged from 1% to 100% of individual municipalities, and averaged 54%. Five ASBF noted expansion in distribution of pocket gophers within their municipalities.

3.3 Severity of Pocket Gopher Problems

Within the distribution zone of pocket gophers, the majority of municipalities rated pocket gopher problems as moderate (59%) or severe (31%) (Table 2). Moderate problems occurred over approximately 5,304,700 ha and severe problems occurred over 3,295,900 ha. They contributed 53% and 33% of the problem area, respectively. The greatest concentration of moderate and severe problems was located in the east-central region of the province, where MacDonald (1967) reported high infestations. Light problems that were scattered around the outer edges of more severe problems contributed 14% of the problem area. In comparison, MacDonald (1967) reported a much larger area of light infestation over the distribution area of pocket gophers. Although our rating system was different than MacDonald's, that the distribution and severity of pocket gopher problems appears to be increasing in Alberta is supported by ASBF comments.

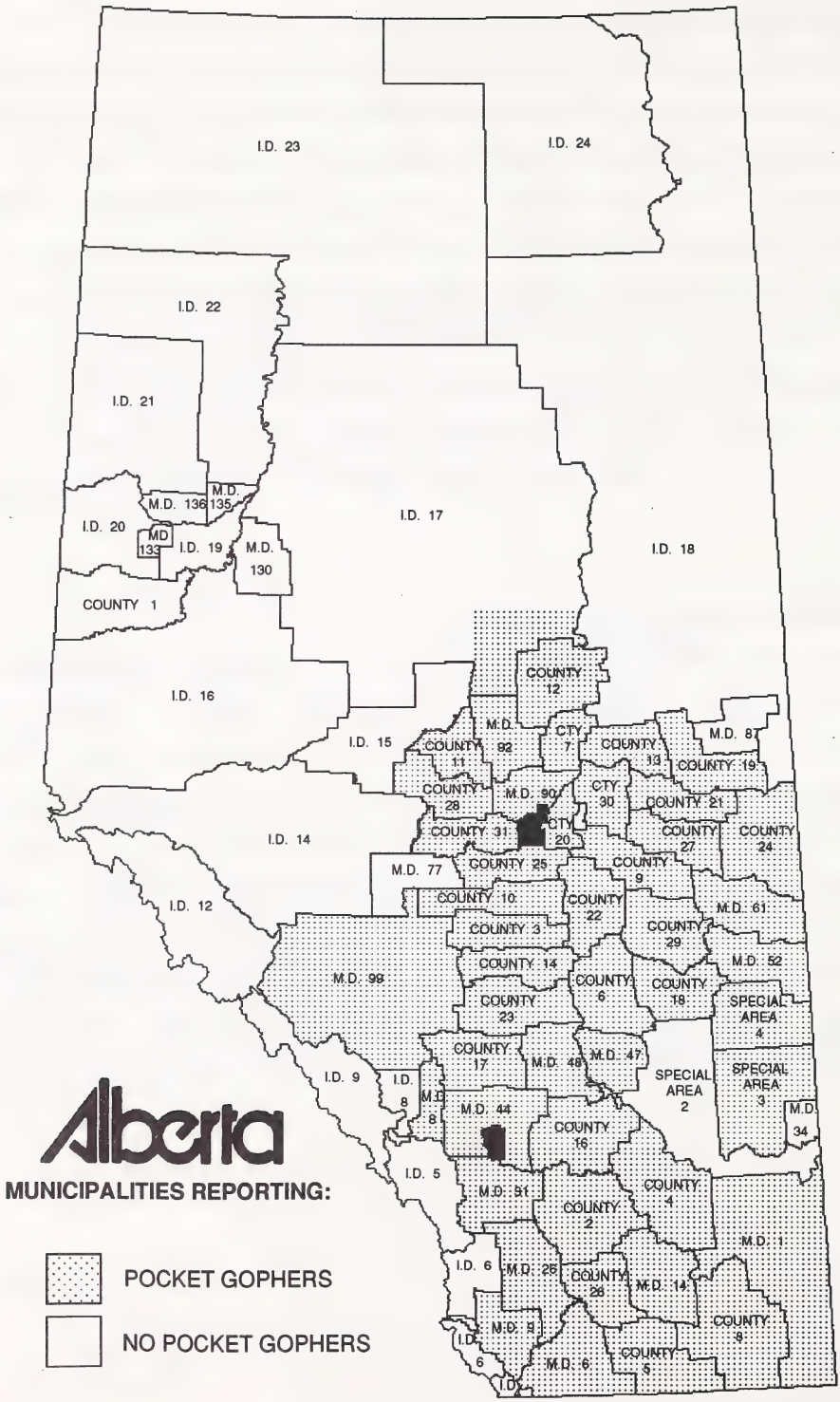

Figure 1. Municipalities reporting the occurance of pocket gophers.

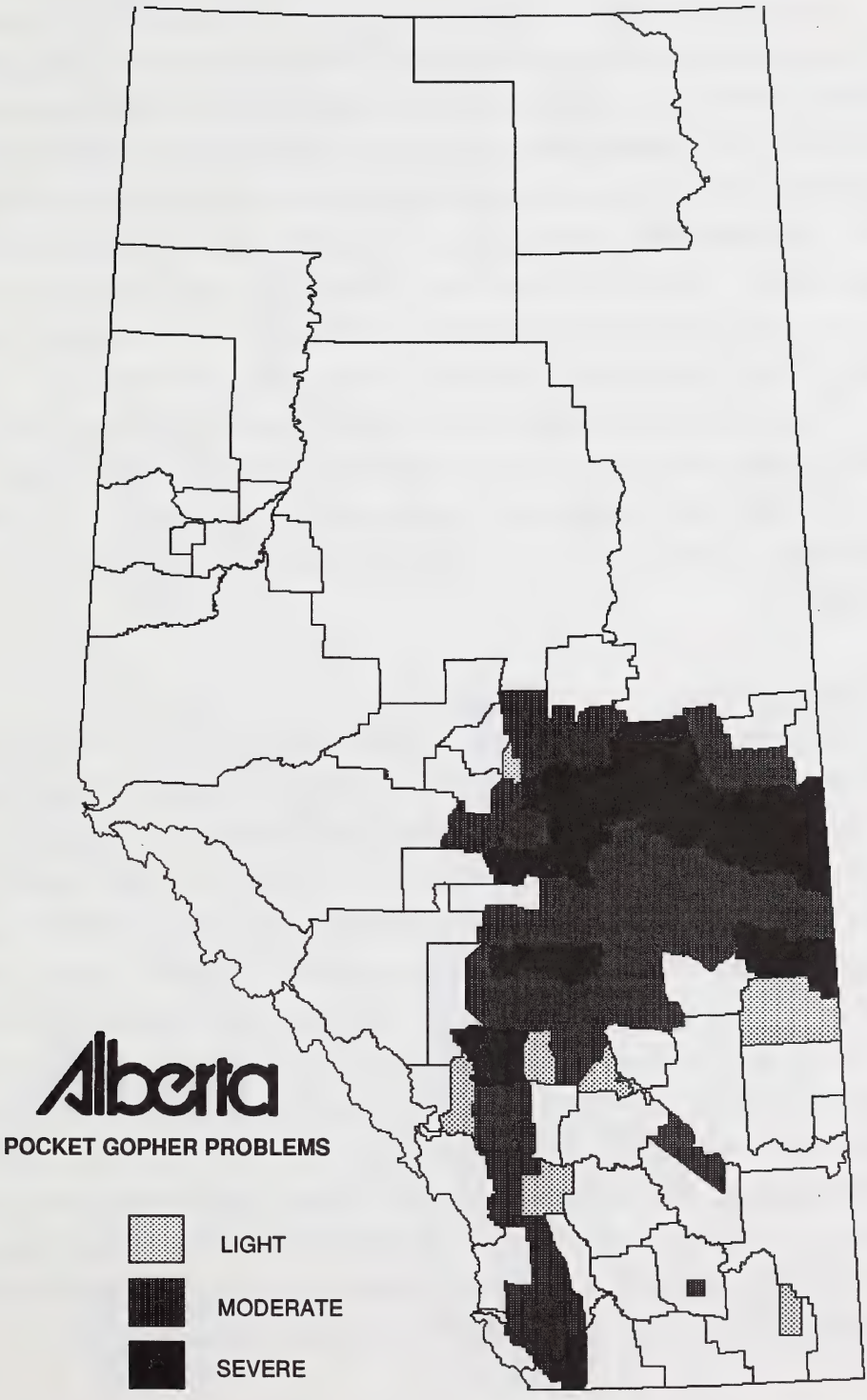

Figure 2. Distribution and severity of pocket gopher problems.

3.4 Forage Association

Pocket gopher problems were almost always rated more severe (35 of 38 ratings) on haylands than pastures. Problems were particularly severe on alfalfa fields (ASBF comments). A preference for alfalfa and other forbs in tame hay vegetation cover was also reported by Polson and Rasmussen (1982) in Saskatchewan. Forbs, such as alfalfa, tend to be higher in digestibility and crude protein than grasses, and may be required by gophers to support their energy expensive lifestyle (Anonymous, 1984a). Pocket gophers can be responsible for substantial loss of forage standing biomass. Decreases in forage yield of 16%-46% have been reported on rangelands (Foster, 1977; Fitch and Bentley, 1949; Alsager, 1977) and yield on alfalfa fields have been reduced by 35-45% (Luce and Case, 1981) as a result of pocket gopher damage.

Pocket gophers were also reported to occur on native pasture, gardens, and grain crops. Generally, gophers are not a problem in cultivated crops, as they are unable to obtain enough energy from grain forage to survive and reproduce (Anonymous, 1984a). High numbers of gophers in grain crops may indicate high neighboring populations or ineffective weed control in grain crops.

3.5 Soil Association

Ambiguity in Question #8 resulted in variable responses of either soil texture(s), soil type(s), or both. More than half of 21 ASBF associated pocket gopher problems with black and/or grey wooded soil types (Table 3). Few gopher problems were reported in brown, solonetzic and peat soils. Similarly, the mapped areas of moderate and severe pocket gopher problems were greater in the black soil zone than other soil zones (Table 4; Figure 3), occurring predominantly in the parkland ecosystems. A preference for the black soil zone was also reported in Saskatchewan (Polson, 1984). The second largest area of gopher problems were associated with the grey wooded soil zones. Both the black and grey wooded soil zones have higher hayland production (ranging from 3332 to 4942 kg/ha), and thus forage resources available to gophers, than brown soils (1151 to 2303 kg/ha) (Anonymous, 1991). As well, one ASBF suggested that brown soils were too dry for gophers. Annual rainfall within brown soil zones is <400 mm, as compared to 440-550 mm for the majority of the black soil zone (Anonymous, 1984b). Problems within brown soil zones were limited in extent, and were primarily associated with irrigated areas that support higher productivity and more desirable vegetation.

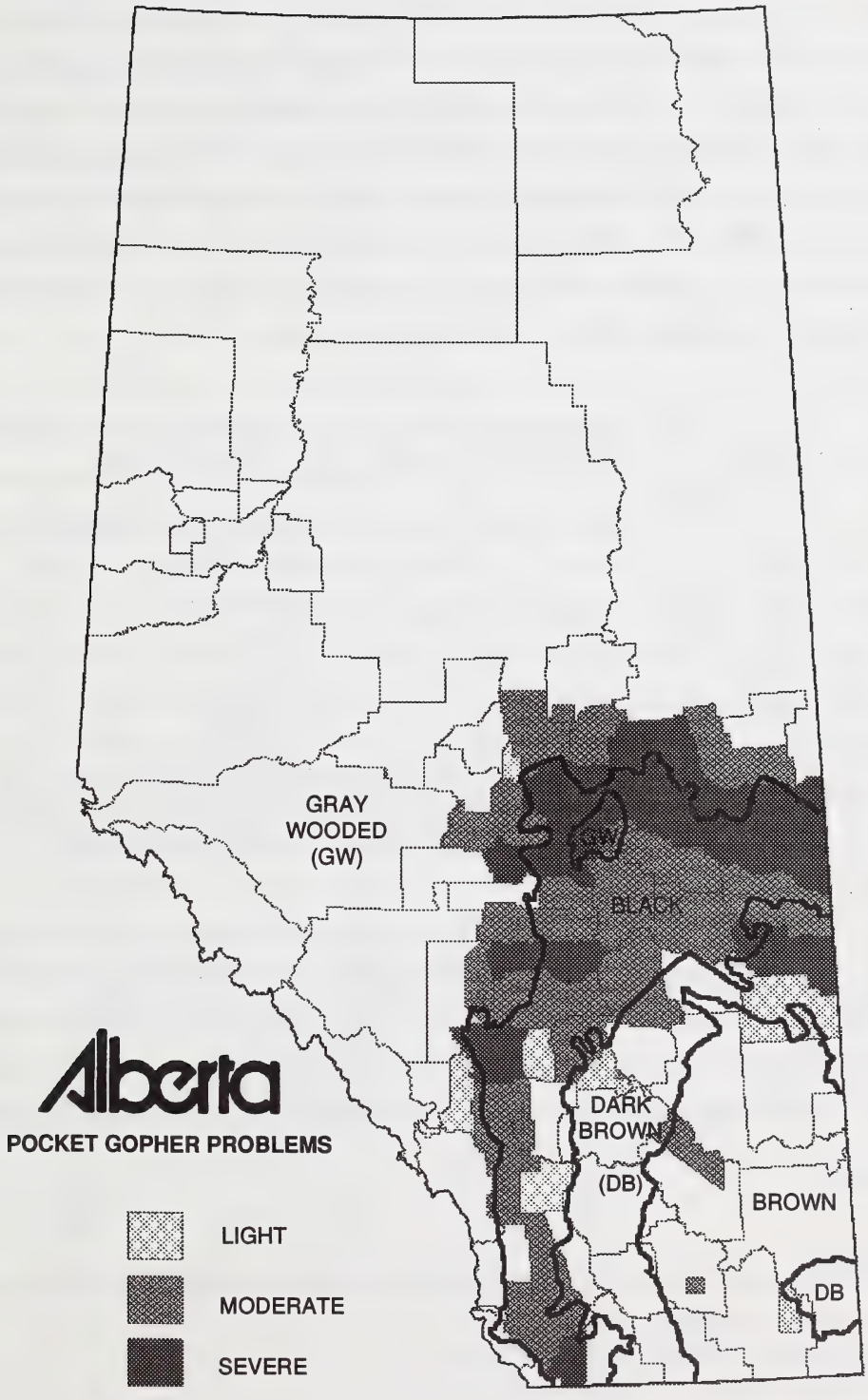

Figure 3. Pocket gopher problems in relation to major soil zones in Alberta.

Soil texture(s) were specified by 38 ASBF (Table 3). Pocket gopher problems were associated with sandy soils in 35 and sandy loams in 7 of these instances. Pocket gopher preference for light, sandy soils was also noted by Polson and Rasmussen (1982), and by Miller (1964) in the United States. Light, sandy soils allow air to diffuse through the closed burrow systems and allow moisture to drain away (Banfield, 1977; Case, 1983). In addition, these soil types may be easier to dig through than compact soils or the hard columnar structure of solonetzic soils. Only a few problems were reported in clay and clay loam soils and none were reported in rocky soils. Clay soils are presumably avoided (Polson and Rasmussen, 1982; Polson, 1984) as they hold water and interfere with diffusion of air (Case, 1983).

Table 3. Soil types and textures associated with areas of pocket gopher problems in Alberta as reported in 1990 survey of Agriculture Service Board Fieldmen.

Soil Types	N[a]	Soil Textures	N[a]
black	13	sandy soils	35
grey wooded	10	sandy loams	7
dark brown	4	loams	7
brown	3	clay	4
peat	2	clay loam	2
solonetzic	1	silty clay loam	1

[a] = number of reports; 9 and 12 ASBFs reported 1 and 2 soil types, respectively; 26, 7, 4 and 1 ASBF reported 1, 2, 3 and 4 soil textures, respectively.

Table 4. Percent of area of severe, moderate and light pocket gopher problems occurring in Alberta within brown, dark brown, black and grey wooded soil groups as determined from 1990 survey of Agriculture Service Board Fieldmen.

	% of Problem Area		
Major Soil Groups	Severe[a]	Moderate[b]	Light[c]
Brown	0	1	14
Dark Brown	12	4	49
Black	63	64	25
Grey Wooded	25	31	12

[a]=Severe problem encompassed 3,295,900 ha
[b]=Moderate problem encompassed 5,304,700 ha
[c]=Light problem encompassed 1,420,400 ha

3.6 Pocket Gopher Control

Pocket gopher control was advocated by 37 of 39 ASBF that reported gopher problems. Eight municipalities advocated only one type of control, while 11, 14 and 4 municipalities advocated 2, 3 and 4 different control methods, respectively. Overall, 54% of the 37 municipalities that advocated control were not satisfied with the methods used, 39% were satisfied, and 7% were unsure of the effectiveness of control. The number of municipalities satisfied and unsatisfied with control did not differ significantly between severe (satisfied=6, unsatisfied=6) and moderate (satisfied=9, unsatisfied=13) problem areas (X^2=0.260, df=1, $P \geq 0.05$). This suggests that moderate gopher problems may be as difficult to control as severe problems. In addition, 4 of 9 municipalities in which gophers occurred but were not a problem advocated control.

3.6.1 Trapping

Thirty municipalities advocated trapping as a method of controlling pocket gopher problems. Thirteen (43%) of these municipalities reported trapping to be effective, although 11 indicated that it was very time consuming. Trapping was significantly more satisfactory as a control method than poisoning (X^2=5.47, df=1, $P \leq 0.05$, Table 5), and than all other methods combined (X^2=7.35, df=1, $P \leq 0.05$, Table 5). No significant difference in satisfaction was found between areas with severe and moderate problems ($P > 0.05$). Traps are probably more effective when pocket gopher numbers are low, due to the number of traps needed to remove all gophers, and the time requirement to check traps. A minimum of 20-40 traps should be used to effectively remove gophers from fields >16 ha (Anonymous, 1984a). The timing of trapping was considered by ASBF to be important in the effectiveness of control. Trapping is most effective in spring when pocket gopher numbers are lower, though mounds may be less conspicuous than in the fall. In the fall, however, a large portion of the population consists of juveniles, which would not survive the winter, making fall trapping less effective.

Table 5. Number of municipalities satisfied and unsatisfied with control methods in relation to severity of pocket gopher problems, as reported in 1990 Alberta Survey of Agricultural Service Board Fieldmen.

Control Method	Satisfaction	Severity of Pocket Gopher Problem		
		Severe	Moderate	Light
Trapping	Satisfied	5	7	1
	Unsatisfied	6	10	0
	Unsure	0	1	0
Mechanical Poisoning	Satisfied	1	3	0
	Unsatisfied	5	13	1
	Unsure	1	2	0
Hand Poisoning	Satisfied	0	2	0
	Unsatisfied	4	5	3
	Unsure	1	3	0
Fumigants	Satisfied	0	0	0
	Unsatisfied	1	3	0
	Unsure	1	1	0
Miscellaneous	Satisfied	0	0	0
	Unsatisfied	1	1	0
	Unsure	0	3	0

3.6.2 Poisons

Hand poisoning and/or mechanical poisoning using the burrow builder were advocated by 30 municipalities, with 4% reporting satisfaction. The limited success of poison baits is consistent with the literature (Ray, 1978; Case, 1983; Tickes, 1983; Godfrey, 1987). Control failure of poison baits has been linked to palatability and toxicant dosage (Marsh and Howard, 1978; Godfrey, 1987). No difference in satisfaction was found between poisons delivered by hand or by mechanical means ($\underline{P}>0.05$, Table 5). No significant difference in satisfaction was found between areas with moderate and severe problems ($\underline{P}>0.05$, Table 5).

3.6.2.1 Mechanical Poisoning

Mechanical poisoning using the burrow builder was the second most commonly used control method in Alberta. The burrow builder is a device which mechanically delivers bait underground, allowing large areas to be treated for gophers. Only 4 of 26 municipalities reporting burrow builder use found it to be satisfactory in controlling gophers. ASBFs commented that the burrow builder gave unpredictable results and its effectiveness was influenced by soil conditions. Burrow builders generally do not work well on soil that are sandy, rocky, dry or shallow (Anonymous, 1984a), and may be restricted by topography and obstructions (Barnes, 1973). Two factors which may have contributed to the ineffectiveness of the burrow builder were that the majority of problems were associated with sandy soils and that the severity of problems was generally high. Timing of baiting was considered to be important, although no further elaboration was made.

3.6.2.2 Hand Baiting

Hand baiting with poison, primarily strychnine, was satisfactory in only 2 of 18 municipalities. A concentration of 5% strychnine was commented as being more effective than 2% strychnine. Although hand baiting is more efficient than trapping, it is still too time consuming to allow adequate treatment of extensive areas (Barnes, 1973). Effective control by hand baiting is likely to be achieved only when gopher populations are low, before serious damage has occurred.

3.6.3 Fumigants

The use of various fumigants (anhydrous ammonia gas, carbon monoxide, smoke bombs) as a means of pocket gopher control was attempted in 6 instances within 5 municipalities. This control method was not satisfactory in 4 of 4 instances of use where results were reported. Fumigants are not effective in sandy or dry soils where gases may rapidly dissipate (Case, 1983). As well, burrow systems can be large and animals may plug off portions of their burrows to keep out detected poisonous gases (Marsh and Howard, 1978).

3.6.4 Agricultural Practices

Three municipalities advocated indirect agricultural practices (crop rotation) as a control for pocket gophers. The use of this method requires long term planning (Anonymous, 1984a), a factor which may have contributed to its low use. Three ASBFs also reported landowners to be ploughing their hayfields under to eliminate their gopher problems. Other agricultural practices such as the use of grasses, rather than forbs, as forage hay along with broad-leaf weed control could reduce gopher problems in haylands (Anonymous, 1984a).

3.6.5 Miscellaneous

Drowning and electrical methods were undertaken in two municipalities to reduce pocket gopher numbers. These methods were unsatisfactory as a means of control.

3.7 Pocket Gopher Damage Estimates

For purposes of this investigation, the area of pocket gopher impact on agriculture was calculated as the amount of tame haylands and improved pasture within problem areas. This represented 1,451,920 ha or 14% of the area over which pocket gopher problems are distributed (Table 6).

Agricultural economic loss due to the activities of pocket gophers were estimated for haylands only, as gopher problems were more severe in hayfields than pastures. As well, losses due to gophers on pastures are indirect and are influenced by stocking rates, thus being difficult to estimate. Maximum losses on haylands were estimated at approximately $24 million for severe problem areas and $28 million for moderate problem areas. Total losses ranged from approximately $50 million, when $60/tonne forage values were used, to $25 million when $30/tonne was used.

Table 6. Estimated area of pocket gopher impact, as defined by the area of tame haylands and improved pastures, for light, moderate and severe problem distributions within Alberta as reported in 1990 survey of Agricultural Service Board Fieldmen.

	Estimated Area of Pocket Gopher Impact	
Problem Rating	Tame Hayland (ha)	Improved Pasture (ha)
light	48,970	67,960
moderate	406,400	419,870
severe	267,390	241,330

4 CONCLUSION

Pocket gophers represent an important, costly problem to forage producers. They occur over much of the agricultural area of central and southern Alberta and are reported to be expanding in distribution. Problems associated with their occurrence appear to have increased within the last 20-25 years, and are mainly moderate to severe in nature.

Gopher problems result where soil characteristics and forage resources are favourable for population growth. Pocket gopher problems are generally associated with haylands and sandy, lighter textured soils throughout their distribution. The majority of problems occur within the black soil zone where better quality soils and forage productivity occurs. Few problems are associated with the brown and dark brown soil zones and with clay, solonetzic, and peat soils.

Pocket gophers are difficult to control once they become well established in an area, regardless of the control method used. Trapping appears to be the most effective control method, but it is labor intensive and thus impractical in large fields. Most pocket gopher problems in Alberta appear to be beyond effective control using conventional methods. Ploughing problem areas under would remove gophers from a field. However, this will have little benefit in the long term for new forage crops unless active control is undertaken while gopher populations are low, and continued to maintain low populations.

5 REFERENCES

Anonymous. 1984a. Control of pocket gophers and ground squirrels. Print Media Branch, Alberta Agriculture, 7000 - 113 Street, Edmonton, Alberta. 4 pp.

Anonymous. 1984b. The Atlas of Alberta. Interwest Publications Ltd., Edmonton, Alberta. 160 pp.

Anonymous. 1987. The 1986 Census of Agriculture for Alberta. Statistics Branch, Alberta Agriculture, Edmonton, Alberta.

Anonymous. 1991. Forage Insurance 1991. Alberta Hail and Crop Insurance Corporation, Alberta Agriculture, Agriculture Canada.

Alsager, D.E. 1977. Impact of pocket gophers (*Thomomys talpoides*) on the quantitative productivity of rangeland vegetation in Southern Alberta: a damage assessment tool. Pages 47-57 in: W.B. Jackson and R.E. Marsh, eds. Test methods for vertebrate pest control and management materials, ASTM STP 625. Am. Soc. for Test. and Mater., Philadelphia. 256 pp.

Banfield, A.W.F. 1977. Mammals of Canada. National Museum of Natural Sciences. National Museum of Canada, University of Toronto Press, Toronto. 438 pp.

Barnes, V.G., Jr. 1973. Pocket gophers and reforestation in the Pacific Northwest: A problem analysis. U.S. Dept. Interior, Fish and Wildlife Service, Washington, D.C., Special Report, Wildlife No. 155. 18 pp.

Case, R.M. 1983. Pocket gophers. Prevention and Control of Wildlife Damage. Pages B12-B26 in: Council Wildlife Resources Committee and Nebraska Cooperative Extension Service, Univ. of Nebraska, Lincoln.

Ellison, L. and C.M. Aldous. 1952. Influence of pocket gophers on vegetation of subalpine grassland in central Utah. Ecology 33(2):177-186.

Fitch, H.S. and J.R. Bentley. 1949. Use of California annual-plant forage by range rodents. Ecology 30:306-321.

Foster, M.A. 1977. Impact of the plains pocket gopher (*Geomys bursarius*) on rangeland. M.S. Thesis. Univ. Wyoming, Laramie. 91 pp.

Godfrey, M.E.R. 1987. A novel strategy for pocket gopher control. USDA Forest Service General Technical Report RM-154. 5 pp.

Grinnell, J. 1923. The burrowing rodents of California as agents in soil formation. J. Mammal. 4:137-149.

Howard, W.E. and H.E. Childs, Jr. 1959. Ecology of pocket gophers with emphasis on *Thomomys bottae mewa*. Hilgardia 29:277-357.

Keith, J.O., R.M. Hansen, and A.L. Ward. 1958. Changes in abundance and food habits of pocket gophers following treatment of range with 2-4-D. J. Wildl. Manage. 23:137-145.

Laycock, W.A. and B.Z. Richardson. 1975. Long-term effects of pocket gopher control on vegetation and soils of a subalpine grassland. J. Range Manage. 28(6):458-462.

Loree, J.W. 1992. Custom Rates 1992. Alberta Agriculture, Agdex No. 825-9. 22 pp.

Luce, D.G. and R.M. Case. 1981. Damage to alfalfa fields by plains pocket gophers. J. Wildl. Manage. 45:258-260.

MacDonald, S.J. 1967. Rodent Damage to Buried Cables; Final Report. Alberta Government Telephone, General Staff Engineering, Outside Plant Standards. 8 pp.

Marsh, R.E. and W.E. Howard. 1978. Vertebrate pest control manual. Pest Control pp. 30-32.

Miller, R.S. 1964. Ecology and distribution of pocket gophers (*Geomyidae*) in Colorado. Ecology 45:256-272.

Polson, J.E. 1984. Saskatchewan Telecommunications Pocket Gopher Damage Assessment Analysis of the 1983 Questionnaire. Sask. Res. Coun. Pub. No. E-902-14-E-84. 40 pp.

Polson, J.E. and R.L. Rasmussen. 1982. An Investigation of Pocket Gopher Distribution in Saskatchewan. Sask. Res. Coun. Pub. No. C-805-59-E-82. 32 pp. + 2 maps.

Ray, V. 1978. Responses of pocket gophers (*Thomomys mazama*) to baiting with strychnine oats plus attractant in polyethylene bags. Tech. Rep. Pocket Gopher 042-4102/78/84. Centralia, WA: Weyerhaeuser Company, Western Forestry Research Center. 5 pp.

Siegel, S. 1956. Nonparametric Statistics for the Behavioral Sciences. McGraw-Hill Book Company, Inc. New York. 312 pp.

Smoliak, S., D. Penney, A.M. Harper, and J.S. Horricks. 1981. Alberta Forage Manual, Alberta Agriculture, Agdex No. 120/20-4. 87 pp.

Steel, R.G.D. and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc. New York. 480 pp.

Tickes, B.R. 1983. Gopher control in Alberta. Proc. 13th Conf. Alfalfa Symp., Cooperative Extension, Univ. Calif. pp. 68-71.

Ward, A.L. 1960. Mountain pocket gopher food habits in Colorado. J. Wildl. Manage. 24:89-92.

APPENDIX A. 1990 Pocket gopher questionnaire directed at Alberta Agricultural Service Board Fieldmen.

QUESTIONNAIRE

DATE:_____

AREA: MD_____
ID_____
COUNTY_____
SPECIAL AREA_____

NAME OF INTERVIEWEE:_____

1. How long have you been in this area? _____ yrs

2. How familiar are you with pocket gopher problems associated with forage and livestock production? Very _____
Moderate _____
Little _____

3. Do you have pocket gophers in your area (MD, ID, etc.) Y _____
N _____

4. Are pocket gophers a problem in your area? Y _____
N _____

5. If yes, how severe of a problem? (Percentage of haylands and pasture covered with mounds) Severe (>35%) _____
Moderate (11-34%) _____
Light (0-10%) _____

6. If yes, over how much of your area (MD, ID, etc.) _____%

7. If yes, are problems more severe in haylands _____ or pastures _____?

8. If yes, what types of soils do pocket gopher problems occur in?
_____

9. What type of control do you advocate?
_____
_____
_____
_____

10. Are producers satisfied with the results of this control? _____

Comments:
_____
_____
_____